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(71)Applicant : ROHM CO LTD

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(72)Inventor : TANIMURA MASANORI

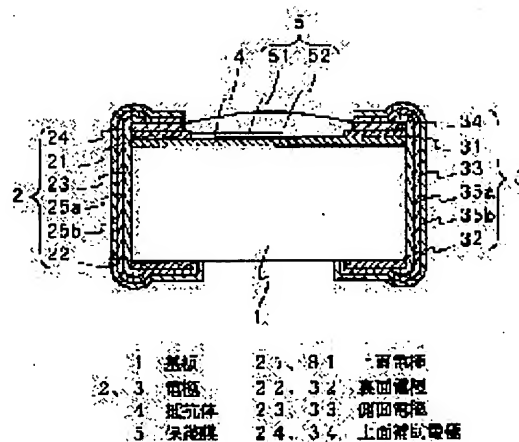
(54) CHIP RESISTOR

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a chip resistor the productivity of which can be improved while the accuracy of its resistance value and, at the same time, its resistance characteristic, such as the noise characteristic, etc., are improved.

SOLUTION: A thin film resistor 4 is formed on a rectangular insulating substrate 1 made of alumina, etc., so that the resistor 4 may be extended toward both ends of the substrate 1 facing each other. On the surfaces of both end sections of the resistor 4, a pair of electrodes 2 and 3 are formed by providing a pair of thick film top surface electrodes 21 and 31 on the surfaces of the end sections, a pair of thick film back electrodes 22 and 32 at the portions corresponding to the electrodes 21 and 31

on the backside the substrate 1, and a pair of thick film side-face electrodes 23 and 33 which electrically connect the top surface electrodes 21 and 31 to the back electrodes 22 and 32, respectively, on the side faces of the end sections of the substrate 1. In addition, a protective film 5 is provided on the surface of the resistor 4 put between the top surface electrodes 21 and 31.



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CLAIMS

[Claim(s)]

[Claim 1] An insulating substrate and the resistor of the thin film prepared on this substrate so that it may extend in the direction of both ends as for which this substrate carries out phase opposite, The top-face electrode of the thick film of the pair prepared in the both-ends front face of this resistor, and the rear-face electrode of the thick film of the pair prepared in the part corresponding to said top-face electrode in the rear face of said insulating substrate, The chip resistor which consists of a protective coat which is prepared in the side face of said both ends of said insulating substrate, and is prepared in said resistor front face across which it faces between the side-face electrode of the thick film of a pair which connects electrically said top-face electrode and rear-face electrode, respectively, and the top-face electrode of said pair.

[Claim 2] The chip resistor according to claim 1 to which it comes to prepare the top-face auxiliary electrode of the thick film by which said top-face electrode is formed of baking of a metal system glass paste, and is formed with a silver system resin paste between the connections of this top-face electrode and said side-face electrode.

[Claim 3] The chip resistor according to claim 1 with which hardening of a silver system resin paste comes to form said top-face electrode.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the chip resistor with which the resistor film is prepared on the insulating substrate of a chip mold. While a production process can be easy and can manufacture cheaply in more detail, it is related with the chip resistor with which a highly efficient property is acquired.

[0002]

[Description of the Prior Art] The conventional chip resistor has printing, the thick film resistor which forms an electrode and a resistor by baking, and the thin film resistor which manufactures an electrode and a resistor by sputtering etc. Structure is structure as been the almost same structure, for example, both indicated to be to drawing 4, although there is a difference between a thick film and a thin film. That is, it is formed in the both ends to which the insulating substrate 1 which consists of an alumina etc. counters by drawing 4 with the side-face electrodes 23 and 33 with which the electrodes 2 and 3 of a pair connect these with the top-face electrodes 21 and 31 and the rear-face electrodes 22 and 32, and the resistor 4 is formed on the insulating substrate 1 so that it may connect with two electrodes. And the protective coat 5 is formed in the front-face side of a resistor by 1-3 layers. In addition, a thick film is formed in the thickness of about 5-10 micrometers, and a thin film is formed in about 0.1-0.5 micrometers.

[0003] A thick film resistor applies the ingredient made into the shape of a paste using glass or resin by printing etc., and is obtained by making it harden by about 600-1000 degrees C at baking (in the case of glass), or about 200-240 degrees C (in the case of resin). As an electrode material, what mixed Ag system (silver system) which added Pd to Ag, Ag for metal pastes, such as Au, nickel, and Cu, being used and making it resistance required for ruthenium oxide (RuO₂) as a resistor ingredient, Pd, etc., and was made into the shape of a paste with glass or resin is used. Moreover, a thin film resistor is obtained by forming membranes by sputtering etc. and carrying out patterning of the metallic material, aluminum, Cu, nickel, etc. are used as an electrode material, and a nickel-Cr alloy etc. is used as electrical resistance materials.

[0004] Thus, to a production process preparing one side by printing and heat treatment, another side is prepared by sputtering etc., and it differs, and differs also in facility sides, such as an airline printer and a sputtering system, and production lines completely differ. Therefore, a production process becomes complicated and is difficult for using both film together practical. Moreover, since the adhesion force will decline, contact resistance will increase and resistance will not become fixed, either, if a thick film is formed on a thin film, there is no example which formed the resistor with the thin film at least, and formed the side-face electrode connected on it with the thick film.

[0005]

[Problem(s) to be Solved by the Invention] As mentioned above, there are a thick film resistor and a thin film resistor in a chip resistor, the manufacturing facility of a thick film resistor is very cheap, and the resistor itself can be manufactured cheaply. However, a thick film resistor makes oxidation RUTENIMU

the shape of glass powder etc. and a paste, and it has the problem that noise figure is inferior in respect of engine performance, such as being bad, with mixing of a glass ingredient etc. while the precision of the resistance acquired by difference of additions, such as Ag and Pd, etc. for the homogeneity of the presentation, the homogeneity of the thickness in the case of applying, and resistance adjustment is inferior. Moreover, although precision, noise figure, etc. of resistance are excellent, a thin film resistor requires time amount for having to use a sputtering system etc. and forming each film, and has the problem of becoming quite expensive.

[0006] On the other hand, when a thick film and a thin film are mixed, and the complexity of the above production lines also forms a thin film on a thick film with last thing, there is no problem of adhesion, but when a thick film is formed on a thin film, adhesion falls, contact resistance increases and there is a problem that quality is not fixed.

[0007] This invention aims at offering the chip resistor which can raise productivity, making resistive characteristics, such as noise figure, good while it was made in view of such a situation and raises the precision of resistance.

[0008]

[Means for Solving the Problem] By this invention person's forming the resistor greatly influenced to a resistive characteristic with a thin film, and forming all of other electrodes, protective coats, etc. with a thick film In order to reduce a manufacture man day sharply and to obtain a cheap and highly efficient chip resistor, maintaining a resistive characteristic to high performance, By choosing the ingredient of forming the thick-film electrode of a metal system glass paste, or the thick-film electrode by the silver system resin paste, even when forming a thick-film electrode on a thin film resistor, as a result of repeating examination wholeheartedly It found out that the side-face electrode of a thick film could be formed in a thin film resistor by being prepared with sufficient adhesion, and forming a side-face electrode so that the thick-film electrode may be contacted. The glass component of metals, such as Au, nickel, and Cu, means the paste of a binder, and, as for a metal system glass paste, the resin with which a silver system resin paste uses silver as a principal component means the paste of a binder here.

[0009] The resistor of the thin film prepared on this substrate so that the chip resistor by this invention may be prolonged in the direction of both ends as for which an insulating substrate and this substrate carry out phase opposite, The top-face electrode of the thick film of the pair prepared in the both-ends front face of this resistor, and the rear-face electrode of the thick film of the pair prepared in the part corresponding to said top-face electrode in the rear face of said insulating substrate, It consists of a protective coat which is prepared in the side face of said both ends of said insulating substrate, and is prepared in said resistor front face across which it faces between the side-face electrode of the thick film of a pair which connects electrically said top-face electrode and rear-face electrode, respectively, and the top-face electrode of said pair.

[0010] A thick film means the film thickly formed by applying to the shape of a paste by carrying out an electrode and the ingredient of a resistor, and making it calcinate or harden here, and a thin film means the film formed thinly by forming a metal membrane directly by the sputtering method etc.

[0011] Since the resistor is formed with the thin film by making it this configuration, while being formed with a precision uniformly [resistance] and sufficient by being formed in fixed thickness of a very uniform component, since a fixed temperature coefficient peculiar to that metal is obtained and a glass component etc. is not contained, noise figure is also good and a temperature coefficient also serves as a resistor which was very excellent in the electrical property. On the other hand, if the ingredient is selected by forming a top-face electrode with a thick film on a thin film resistor, the side-face electrode which is formed with a thin film resistor and sufficient adhesion, contacts the top-face electrode and is formed will also be formed with a top-face electrode and sufficient adhesion with thick films.

Consequently, it can form without producing contact resistance, even if it forms all electrode materials with a thick film, and most production processes can be formed according to an easy thick-film process.

[0012] When said top-face electrode is formed of baking of a metal system glass paste, by preparing the top-face auxiliary electrode formed with a silver system resin paste between the connections of this top-face electrode and said side-face electrode, the resistance over a pewter improves, it is lost that melting

is carried out to a pewter and dependability improves.

[0013] Since it is not necessary to calcinate at an elevated temperature while adhesion with a thin film resistor is acquired good if said top-face electrode is formed of hardening of a silver system resin paste, oxidization of a resistor etc. is not generated but a highly efficient chip resistor is obtained by the easy production process.

[0014]

[Embodiment of the Invention] Next, the chip resistor of this invention is explained, referring to a drawing. The resistor 4 of a thin film is formed so that the flat-surface configuration which as for the chip resistor by this invention the cross-section explanatory view of the 1 operation gestalt becomes from an alumina etc. as is shown in drawing 1 may be prolonged on the insulating rectangle-like substrate 1 in the direction of both ends which carries out phase opposite. The top-face electrodes 21 and 31 of the thick film of a pair are formed in the both-ends front face of the resistor 4. The rear-face electrodes 22 and 32 of the thick film of a pair are formed in the part corresponding to the top-face electrodes 21 and 31 in the rear face of the insulating substrate 1. The electrodes 2 and 3 of a pair are formed by forming the side-face electrodes 23 and 33 of the thick film of a pair which connects electrically the top-face electrodes 21 and 31 and the rear-face electrodes 22 and 32, respectively in the side face of said both ends of the insulating substrate 1. And the protective coat 5 is formed in the front face of the resistor 4 inserted among the top-face electrodes 21 and 31 of a pair.

[0015] If it puts in another way, the chip resistor by this invention has the description in simplifying the production process by forming only the resistor 4 which influences resistive characteristics, such as precision of resistance, and a noise, greatly with a thin film, and forming other top-face electrodes 21 and 31 and inferior-surface-of-tongue electrodes 22 and 32, the side-face electrodes 23 and 33, etc. with a thick film. That is, although there was a problem of the adhesion having fallen and being easy to generate contact resistance when the thick film was generally formed on the thin film as mentioned above, as a result of this invention person's repeating examination wholeheartedly, it found out that the laminating of the top-face electrodes 21 and 31 of a thick film could be carried out by selecting the ingredient of the thick-film electrode prepared on a thin film resistor 4, without producing the problem. And it could connect with sufficient adhesion with thick films by forming the side-face electrodes 23 and 33 with a thick film so that it might connect with the thick film, and it found out that the side-face electrode of a thick film could be formed in a thin film resistor.

[0016] As for a substrate 1, an alumina, sapphire, or Si wafer is used. What generally mixed metal powder, glass, or resin, and was made into the shape of a paste as an electrode material of a thick film is used, and although Ag system, an Ag-Pd system, Au system, etc. are used with the metal powder to mix, in the example shown in drawing 1, the thick-film electrode which consists of a glass paste of Au system, nickel system, or Cu system is used as top-face electrodes 21 and 31. A "system" means that other elements may be added here, making these into a principal component. In addition, a glass paste is hardened by calcinating at about 600-1000 degrees C, and a resin paste is hardened by carrying out a temperature up to about 200-240 degrees C.

[0017] In the example shown in drawing 1, the top-face electrode 21 and the top-face auxiliary electrodes 24 and 34 which consist of an Ag system resin paste on 31 are formed. And it is formed in the side face of the insulating substrate 1 with the thick-film electrode with which the side-face electrodes 23 and 33 consist of an Ag system resin paste so that the top-face auxiliary electrodes 24 and 34 and the rear-face electrodes 22 and 32 may be connected. These auxiliary electrodes 24 and 34 are formed in order to prevent being eaten away in the case of soldering since it is easy to fuse Au of the top-face electrodes 21 and 31 to a pewter. Moreover, the rear-face electrodes 22 and 32 are formed with the thick film which consists of an Ag system glaze paste (glass paste) or the Au system metal organic substance (glass paste). And the electrodes 2 and 3 of a pair are formed by forming the nickel deposits 25a and 35a and the pewter deposits 25b and 35b on the surface of an electrode.

[0018] A resistor 4 can choose and use metal membranes, such as for example, a nickel-Cr system, Ta system, a Ta-N system, and a Ta-Si system, according to desired resistance. In addition, a "system" means that other elements, such as aluminum, Cr, and O, are added and resistance can be adjusted. This

resistor 4 is formed with the thin film by forming membranes by sputtering etc. and carrying out patterning to a desired configuration according to a photolithography process.

[0019] Although the example of the two-layer structure of the 1st protective coat 51 and the 2nd protective coat 52 is shown by the example shown in drawing 1, there may not be the two-layer need for five protective coat, and one layer or three layers are not necessarily sufficient as it. The 1st protective coat 51 is formed by applying by printing etc. what made glass powder, such as membrane formation of aluminum $2O_3$, SiO_2 , SiN , etc., etc., or lead borosilicate glass, the shape of a paste with the thin film, and calcinating at about 600-1000 degrees C. This 1st protective coat 51 does not especially need to be formed without those worries, although the process which deletes a part of resistor 4 with laser trimming, and is adjusted is established, and it is prepared, measuring that resistance after forming a resistor 4 in order to adjust the resistance of a resistor 4 in order to prevent the resistor ingredient shaved on that occasion scattering, adhering on a resistor 4 again, and the engine performance changing.

[0020] The 2nd protective coat 52 can protect the front face of the resistor 4 exposed by applying on the 1st protective coat 51 which laser trimming is carried out and has irregularity in a front face, can prepare separately the protective coat which fills the inside of the concave by the above-mentioned laser trimming, and can also make the 2nd protective coat two-layer structure. Since the resistance of a resistor 4 may change if it calcinates at an elevated temperature, as for this 2nd protective coat 52, it is desirable to apply the paste made of resin which consists of an epoxy resin etc., and to make it harden at about 200-240 degrees C.

[0021] It explains referring to the flow chart shown in drawing 3 about the process of this chip resistor next. In addition, although the cross-section explanatory view of the chip resistor for one piece is shown in drawing 1, when actually manufacturing, it is manufactured by carrying out cutting separation of the chip resistor which formed the electrode and resistor about 100-10,000 pieces in the about [5-10cmx5-10cm] big substrate at coincidence, formed the side-face electrode in the side face which cuts in the shape of a bar and is exposed, and stood in a row in the shape of a bar after that further at every piece.

[0022] First, the paste of the electrode material which becomes the predetermined location of substrate 1 rear face from Ag system glaze paste or Au system metal organic substance is printed. And the rear-face electrodes 22 and 32 (refer to drawing 1) of a thick film are formed by calcinating at about 600-1000 degrees C (S1). Subsequently, a resistor 4 is formed by forming the electrical resistance materials of a nickel-Cr system or Ta system by sputtering all over substrate 1 front face, and carrying out patterning to a predetermined configuration which is prolonged in the direction to which the both ends of a substrate are connected using a photolithography process (S2). The top-face electrodes 21 and 31 are formed by applying the electrode material which consists of a glass paste of Au system, nickel system, or Cu system by printing, and next, calcinating it on the both-ends (part corresponding to rear-face electrodes 22 and 32) front face of a resistor 4, (S3).

[0023] Then, the 1st protective coat 51 is formed by applying glass pastes, such as lead borosilicate glass, by printing etc., and calcinating them on the front face of a resistor 4, (S4). This process may be skipped. And contacting a probe electrode to the top-face electrodes 21 and 31 of a pair, and measuring resistance, laser trimming is performed and resistance is adjusted so that it may become desired resistance (S5). The 2nd protective coat 52 is formed by making the front face apply and harden a resin paste furthermore (S6). Subsequently, the top-face auxiliary electrodes 24 and 34 are formed by applying the electrode material which consists of an Ag system organic paste (resin paste) which mixed Ag and Pd to resin, for example by printing on the top-face electrodes 21 and 31, and stiffening it at about 200 degrees C (S7).

[0024] Subsequently, a big substrate is cut in the shape of a bar so that it may dissociate for every single tier located in a line in the direction perpendicular to the direction to which the top-face electrodes 21 and 31 of a pair are connected (S8). And the side-face electrodes 23 and 33 are formed by applying and stiffening the electrode material which consists of an Ag system resin paste so that it may lap also on the top-face auxiliary electrodes 24 and 34 and the rear-face electrode 22, and 32 between the top-face auxiliary electrodes 24 and 34 and the rear-face electrodes 22 and 32 (S9). Then, the chip resistor

connected in the shape of a bar is divided into one-piece one chip (S10), and the chip resistor shown in drawing 1 is obtained by what (S11) the pewter deposits 25b and 35b which become the exposure of an electrode from the nickel deposits 25a and 35a, Pb/Sn, etc. are formed for.

[0025] Since according to this invention all electrodes including a side-face electrode are formed with the thick film while only a resistor is formed with a thin film, the man day of a production process cannot increase so much, but can be obtained cheaply. And since the resistor which is easy to affect a resistive characteristic is formed with the thin film by carrying out sputtering of the metallic material, the metal thin film is formed in homogeneity thickness with the homogeneity ingredient, and a very highly precise resistor is obtained. Moreover, if a top-face electrode is prepared in the resistor bottom, it will be hard to check the contact location of the probe for monitors for measuring resistance at a laser trimming process, but since a top-face electrode is prepared in the front-face side of a resistor, there is also an advantage that the check of an electrode becomes easy.

[0026] Under the present circumstances, if thick-film electrodes, such as for example, a side-face electrode, are generally formed on a thin film resistor, the adhesion between both will not be acquired completely but it will be easy to generate contact resistance etc., but in this invention, since the metal paste is used for the top-face electrode, a thin film resistor and a top-face electrode contact with very sufficient adhesion. On the other hand, since a side-face electrode is structure connected with the top-face auxiliary electrode of the thick film prepared the top-face electrode of a thick film, or on it, even if it forms a side-face electrode with a thick film, with thick films, it sticks very much and it is prepared. Consequently, a thin film resistor and the side-face electrode of a thick film are connectable with very small contact resistance.

[0027] Drawing 2 is the cross-section explanatory view showing other operation gestalten of the chip resistor by this invention. Although the above-mentioned example formed the top-face electrodes 21 and 31 by printing and baking of a glass paste of Au system, nickel system, or Cu system, the example shown in drawing 2 has the description in having formed these top-face electrodes 21 and 31 with (Silver Ag) system resin paste. Even if it used such a silver system resin paste, it was checked as a result of examination of this invention person that the adhesion of a thin film resistor 4 is fully acquired. In this example, since the top-face electrodes 21 and 31 are formed with Ag system ingredient with pewter resistance, it is not necessary to prepare an auxiliary electrode on it. Other structures are the same as the example shown in drawing 1, give the same sign to the same part as drawing 1, and omit the explanation. Moreover, a production process is also a process shown in drawing 2, and the point that the ingredients of a top-face electrode differ and the curing temperature differs only differs from the point that a top-face auxiliary electrode is not prepared, and the same of others is completely said of it.

[0028] Since it can carry out at the low temperature the curing temperature of whose is about 200 degrees C by using such an Ag system resin paste as a top-face electrode, there are also no worries about oxidation of a resistor etc. and the cure becomes unnecessary.

[0029]

[Effect of the Invention] According to this invention, while the resistor which influences a resistive characteristic very greatly considers as a highly efficient resistor by forming with a thin film, since all of electrodes, such as other side-face electrodes, are formed with the thick film, a production process can manufacture them very cheaply by the very easy and small man day. And the problem of the adhesion of the side-face electrode and thin film resistor which are formed with a thick film is also solved, and compared with the case where all are formed with a thin film, there is almost no fall of a property and it can be obtained very cheaply.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the cross-section explanatory view showing 1 operation gestalt of the chip resistor by this invention.

[Drawing 2] It is the cross-section explanatory view showing the modification of the chip resistor of drawing 1.

[Drawing 3] It is the flow chart of an example which manufactures the chip resistor of drawing 1.

[Drawing 4] It is a cross-section explanatory view explaining the structure of the conventional chip resistor.

[Description of Notations]

1 Substrate

2 Three Electrode

4 Resistor

5 Protective Coat

21 31 Top-face electrode

22 32 Rear-face electrode

23 33 Side-face electrode

24 34 Top-face auxiliary electrode

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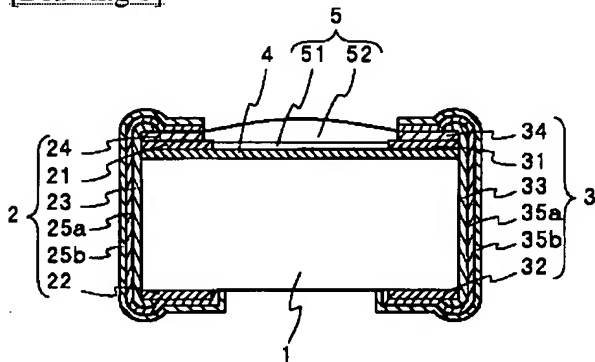
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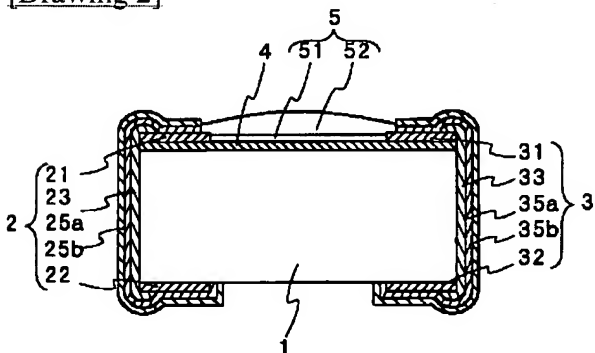
DRAWINGS

[Drawing 1]

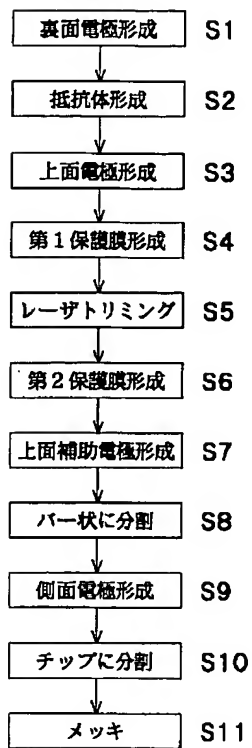


- | | | | |
|-----|-----|-------|--------|
| 1 | 基板 | 21、31 | 上面電極 |
| 2、3 | 電極 | 22、32 | 裏面電極 |
| 4 | 抵抗体 | 23、33 | 側面電極 |
| 5 | 保護膜 | 24、34 | 上面補助電極 |

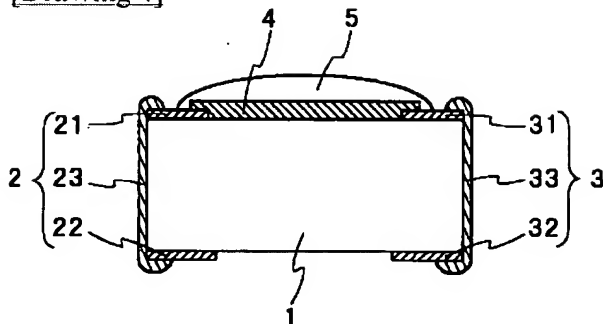
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Translation done.]